a1

1. A non-thermal device for the treatment and/or cure of cardiac arrhythmias comprising an illumination mechanism and an MRI receiver.

a2

3. A photochemotherapy or photodynamic therapy device for the ablation of the pulmonary vein ostia comprising an illumination mechanism and an MRI receiver.

5. The device of claim 1, wherein the illumination mechanism is a fiberoptic laser.

6. The device of claim 5, wherein the MRI receiver and the fiberoptic laser are housed within a balloon.

a3

7. A device for the treatment and/or cure of cardiac arrhythmias, comprising a catheter having a balloon or reservoir at or near its distal end, a light source located within the balloon or reservoir, and an MRI receiver, whereby a photosensitizing agent is perfused into and delivered by the balloon to a desired treatment site and whereby light capable of activating the photosensitizing agent is delivered by the light source through the balloon and to the desired treatment site.

8. A photochemotherapy or photodynamic therapy device for the treatment and/or cure of cardiac arrhythmias comprising:

a catheter;

a balloon at the distal end of the catheter;

a fiberoptic laser within the catheter; and

an MRI receiver within the catheter;

wherein the fiber illuminates an area being treated and wherein the MRI receiver guides the device and/or assists in monitoring the treatment and/or cure of cardiac arrhythmias.

9. The device of claim 8, wherein the fiberoptic laser has a tip and illumination is scattered at the tip of the fiberoptic laser radially through the balloon and into the treatment area.

11. The device of claim 8, wherein the fiber provides illumination at a wavelength capable of activating a photosensitizing agent used in the photochemotherapy or photodynamic therapy.

A4

12. A device for the treatment of cardiac arrhythmias comprising a dual function catheter that combines MR imaging and photochemotherapy or photodynamic therapy.

14. The device of claim 12, wherein the MR imaging monitors endpoints of the photodynamic therapy or photochemotherapy.

15. The device of claim 14, wherein the device further comprises a balloon and provides intravascular balloon angioplasty.

A5

16. A device for the treatment and/or cure of cardiac arrhythmias that induces apoptotic cell death of tissues and pathways from which abnormal signals arise and/or in other cardiac tissues such that abnormal electrical rhythms can not be generated and/or sustained, comprising an illumination mechanism and an MRI receiver.

17. A device for the treatment and/or cure of cardiac arrhythmias that uses free radical generation to destroy tissues and pathways from which abnormal signals arise and/or that destroys other cardiac tissues such that abnormal electrical rhythms cannot be generated and/or sustained, comprising an illumination mechanism and an MRI receiver.

18. A medical device kit, comprising one or more of the devices of any one of claims 1, 3 or 7.

A6

20. A non-thermal method for treating and/or curing cardiac arrhythmias comprising the steps of: utilizing a device according to any one of claims 1, 3, 7, 8, 12, 16 or 17 to destroy tissues and pathways from which abnormal signals arise and/or in other cardiac tissues such that abnormal electrical rhythms can not be generated

and/or sustained, whereby MR imaging is used to guide the device and assist in monitoring the progress of the photochemotherapy or photodynamic therapy.

21. A method for treating and/or curing cardiac arrhythmias using photochemotherapy or photodynamic therapy comprising the steps of:

(a) providing a device comprising an illumination mechanism and an MRI receiver;

(b) administering a photosensitizing agent to a desired treatment site;

(c) inserting the device into the desired treatment site using MRI to guide the device;

(d) delivering laser energy at a wavelength required to activate the photosensitizing agent; and

(e) utilizing MR imaging to assist in monitoring the progress of the photochemotherapy or photodynamic therapy.

a6

22. A method to electrically isolate the pulmonary vein from the left atrium comprising the steps of using photochemotherapy or photodynamic therapy to electrically isolate the pulmonary vein from the left atrium under the guidance of MR imaging.

23. A method of ablating at least a section of the pulmonary vein using photochemotherapy or photodynamic therapy, comprising the steps of using a device according to any one of claims 1, 3, 7, 8, 12, 16 or 17 to ablate at least a section of the pulmonary vein and using MR imaging to monitor the progress of the ablation.

24. A method to treat and/or cure cardiac arrhythmias comprising using photochemotherapy or photodynamic therapy to destroy tissues and pathways from which abnormal signals arise and/or in other cardiac tissues such that abnormal electrical rhythms can not be generated and/or sustained wherein MR imaging is used to guide and monitor the progress of tissue being destroyed.

25. A photodynamic method comprising causing cell death in certain cardiac tissue such that abnormal electrical rhythms can not be generated and/or sustained and using MR imaging to guide and monitor the progress of cell death.

26. A method to treat and/or cure cardiac arrhythmias comprising using the device of any one of claims 1, 3, 7, 8, 12, 16 or 17.

a6

27. A method to treat and/or cure cardiac arrhythmias using photochemotherapy or photodynamic therapy comprising:

delivering a therapeutically effective amount of a photosensitizing agent to the cardiac tissue, wherein the photosensitizing agent is preferentially absorbed by the tissues and pathways from which abnormal signals causing the arrhythmias arise;

activating the photosensitizing agent with an illumination mechanism; and

using MR imaging to guide and monitor the treatment.

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a7

31. The method of claim 21 or 27, wherein the photosensitizing agent is delivered to the cardiac tissue systemically.

32. The method of claim 21 or 27, wherein the photosensitizing agent is delivered to the cardiac tissue by an angioplasty catheter balloon or reservoir mechanism.

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a8

37. The method of claim 21 or 27, wherein the photosensitizing agent is delivered to the cardiac tissue by directly perfusing the photosensitizing agent into the coronary arteries.

38. The method of any one of claims 21, 22, 24, 25 or 27, wherein the photochemotherapy or photodynamic therapy utilizes an illumination mechanism and the illumination mechanism comprises a fiberoptic catheter.

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a9

48. The method of any one of claims 21, 22, 24, 25 or 27, further comprising the step of utilizing MR imaging to monitor coagulation on the endocardial surface.

49. The method of any one of claims 21, 22, 24, 25 or 27, further comprising the step of utilizing MR imaging to monitor oxygenation levels.

a9

50. The method of any one of claims 21, 22, 24, 25 or 27, further comprising the step of utilizing MR imaging to monitor phosphate levels.

Please add the following new claims:

~~55. The device of claim 3, wherein the illumination mechanism is a fiberoptic laser.~~

55. The device of claim 3, wherein the illumination mechanism is a fiberoptic laser.

56. The device of claim 1, wherein the device further includes electrodes for acquiring bio-signals.

a10

57. The device of claim 6, wherein the device further includes electrodes on the surface of the balloons for acquiring bio-signals.

58. The method of claim 20, wherein targeted contrast agents specific for apoptosis are used with MR imaging to guide the device and assist in monitoring the progress of the photochemotherapy or photodynamic therapy.

59. The method of any one of claims 21, 22 24, 25 or 27, wherein targeted contrast agents specific for apoptosis are used with MR imaging to guide the device and assist in monitoring the progress of the photochemotherapy or photodynamic therapy.

60. The device of claim 1 further comprising position trackers that interact with MRI to provide X, Y and Z coordinate tracking of the device.

REMARKS

Claims 1-54 are pending in the subject application. Claims 1, 3, 5-9, 11, 12, 14-18, 20-27, 31, 32, 37, 38 and 48-50 have been amended for clarification purposes and for purposes of correcting typographical errors. Claims 13, 30, 42-47 and 51-54

have been cancelled, without prejudice. Claims 55-60 has been added. Support for the amendment to claims 1, 3, 5-9, 11, 12, 14-18, 20-27, 31, 32, 37, 38 and 48-50 and added claims 55-60 is found throughout the Specification, as filed, and no new matter is presented by the amendment.

Favorable reconsideration in light of the amendments and remarks which follow s respectfully requested.

1. Claim Objections

Claims 5, 18, 19, 26 and 30-50 have been objected to as being in improper form because a multiple dependent claim should refer to other claims in the alternative only and cannot depend from any other multiple dependent claims.

The claims have been amended herein to correct the improper multiple dependent form. Reconsideration and withdrawal of the objection is respectfully requested.

2. 35 U.S.C. §112 Rejections

Claims 1-4, 6, 8-11, 13-17, 20-25, 27-29 and 51-54 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Office states that:

> Claims 1-4 recite a device but have not positive recitation of structure. In claim 6, "the high resolution MRI receiver" and "the fiber optic laser" lack positive antecedent basis. In claim 8, "the coil" and "the treatment area" both lack positive antecedent basis. In claim 9 "the illumination:' "the tip"; and "the fiberoptic laser" all lack positive antecedent basis. In claims 9-11 and 13-15 there is no positive recitation of structure. Claim 11 is further unclear because the term "any one or" is unclear. For the purpose of examination, the term. Will be read as --any one of--. In claim 12 exactly what constitutes "high resolution imaging" is unclear. Claims 16 and 17 recite no structure other than a device. Claim 20, 22, 23, 25 and 51-54 recite no method steps. Claims 21 and 24 lack any transitional phrase (e.g. "comprising", "consisting of") – "comprising" will be assumed. It is also noted that the

claims are replete with functional language which is not of the proper form to be considered structurally limiting. See MPEP 2181.

Applicants respectfully submit that the amendments made herein overcome or render moot the 35 U.S.C. §112, second paragraph rejections. Reconsideration and withdrawal of the rejections is respectfully requested.

3. 35 U.S.C. §102 Rejections

Claims 1-3, 7-17, 20, 21, 24, 25, and 52-54 have been rejected under 35 U.S.C. §102(e) as being anticipated by Motamedi et al. The Office points to column 5, line 55 to column 6, line 17, and Figures 1, 3 and 4.

Applicants respectfully traverse.

Applicants teach non-thermal devices and methods for the treatment and/or cure of cardiac arrhythmias. In particular, Applicants' devices and methods utilize photochemotherapy or photodynamic therapy under magnetic resonance (MR) imaging guidance. Thus, Applicants' devices and methods enable (1) photochemotherapy or photodynamic therapy for the treatment and/or cure of cardiac arrhythmias, (2) accurate positioning the photochemotherapy or photodynamic therapy device within the cardiac chambers using MR imaging and (3) monitoring of the endpoints of the photochemotherapy or photodynamic therapy using MR imaging.

Current methods for monitoring such procedures involve X-ray fluoroscopy. These methods are lacking in several respects. Under X-ray fluoroscopy, soft tissues are not detectable and are not visible. Further, feedback is electrical rather than visual. Further, electrical feedback is not particularly reliable. Thus, Applicants' devices and methods for performing MR imaging of the treatment area is extremely useful in several ways. First, it is important to accurately position the catheter within the cardiac chambers (e.g. to position the probe in the pulmonary vein orifices). Guidance in accurately placing the catheter can be based upon local anatomical landmarks and, thus, MR cardiac imaging will be particularly beneficial. Further, because the procedure takes place in the left atrium, the risk of generating emboli is of

particular concern. Use of local MR imaging will allow the surgeon to watch for any coagulation on the endocardial surface. Still further, MR imaging can be used to titrate and direct therapy delivery. For example, MR imaging can be used to monitor oxygenation levels, which is particularly important in photodynamic therapy because photodynamic therapy causes increased oxygen consumption. Using MR imaging, tissue oxygen saturation can be imaged (the change from diamagnetic oxyhemoglobin to paramagnetic deoxyhemoglobin results in decreased signal intensity). This can be used to determine which tissue is affected and also to control light intensity to ensure that tissue does not become so hypoxic as to reduce free radical generation. MR imaging can also be used to monitor phosphate levels, which is particularly important in photodynamic therapy because with photodynamic therapy, induced cellular damage, especially mitochondrial damage, rapid deterioration of ATP concentration is expected. If the mitochondrial membrane is compromised, cells have little ability to compensate for this change. Thus, MR imaging can be an excellent marker of overall cellular metabolic state and eventual response to photochemotherapy or photodynamic therapy. MR imaging can further be used to perform sodium imaging, wherein a change in sodium signal strength, which is proportional to cellular depolarization/damage, will be observed.

The Motamedi reference, on the other hand, describes a method and device for the treatment of cardiac disorders wherein the method and device (1) delivers laser light or other ablating energy intramyocardially and (2) diffuses the ablating energy over the broad area in the myocardium without causing excessive heat on the endocardial surface or in the blood pool. (See col. 2, lines 39-43)

Motamedi does not describe or otherwise suggest a device for treating and/or curing cardiac arrhythmias comprising an illumination mechanism and an MRI receiver. Further, Motamedi does not describe or otherwise suggest a method wherein photochemotherapy or photodynamic therapy is performed using MR imaging to guide and/or monitor the procedure.

Accordingly, claims 1-3, 7-12 and 14-17, 20, 21, 24 and 25 are patentable over the Motamedi reference. Claims 13 and 52-52 have been cancelled, without prejudice, and, thus, rejection of these claims is moot.

4. 35 U.S.C. §013 Rejections

Claims 22, 23 and 51 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Swanson in combination with Motamedi et al. The Office states that:

> Swanson teaches that one of the ectopic foci involved in arrhythmias is the pulmonary vein. Motamedi et al teach that both PDT and various forms of ablation can be used to control arrhythmias. It would have been obvious to the artisan of ordinary skill to monitor endpoints as claimed so as to avoid over treatment and to employ PDT to ablate the tissue of the pulmonary vein causing the arrhythmia n the method of Swanson, since these are equivalents in the art, as taught by Motamedi et al, or alternatively to ablate the tissue of the pulmonary vein causing the arrhythmia in the method of Motamedi et al, since this is a known area that can be involved in arrhythmias, as taught by Swanson, thus producing a method such as claimed.

Applicants respectfully traverse for the reasons set forth above. In particular, the Motamedi reference merely describes a method and device for the treatment of cardiac disorders wherein the method and device (1) delivers laser light or other ablating energy intramyocardially and (2) diffuses the ablating energy over the broad area in the myocardium without causing excessive heat on the endocardial surface or in the blood pool.

Motamedi does not describe or otherwise suggest a device for treating and/or curing cardiac arrhythmias comprising an illumination mechanism and an MRI receiver. Further, Motamedi does not describe or otherwise suggest a method wherein photochemotherapy or photodynamic therapy is performed using a device wherein MR imaging to guide and/or monitor the procedure.

The Swanson reference is equally deficient. Swanson describes systems and methods for diagnosing and treating tissue by transmitting an electrical energy pulse that temporarily stuns a zone of tissue temporarily rendering it electrically unresponsive. According to Swanson, an electrophysiological effect due to the transmitted pulse enables a physician to determine if the temporarily unresponsive tissue is the tissue that is intended for modification. If the temporarily unresponsive tissue is the tissue that is intended for modification, then the electrophysiological property of tissue is altered by, for example, ablation or medication. Swanson does not describe or otherwise suggest a device for treating and/or curing cardiac arrhythmias comprising an illumination mechanism and an MRI receiver. Further, Motamedi does not describe or otherwise suggest a method using such a device wherein photochemotherapy or photodynamic therapy is performed and wherein the MR receiver is used to guide and/or monitor the procedure.

Accordingly, claims 22 and 23 are patentable over Swanson in combination with Motamedi et al. Claim 51 has been cancelled, without prejudice, and, thus, rejection of this claim is moot.

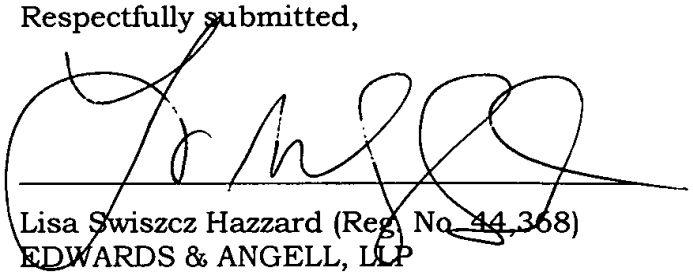
CONCLUSION

Reconsideration and allowance of claims 1-12, 14-29, 31-41, 48-50 and 55 is respectfully requested in view of the foregoing discussion. This case is believed to be in condition for immediate allowance. Applicants respectfully requests early consideration and allowance of the subject application.

Applicants conditionally petition for an extension of time to provide for the possibility that such a petition has been inadvertently overlooked and is required. As provided below charge Deposit Account No. **04-1105** for any required fee.

Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned attorney would appreciate the opportunity to do so.

Respectfully submitted,



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